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DEMOGRAPHIC MONITORING OF PENSTEMON LEMHIENSIS
BEAVERHEAD NATIONAL FOREST
1991 PROGRESS REPORT

by

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I. INTRODUCTION

This report summarizes the results from three years of demographic monitoring studies in populations of Penstemon lemhiensis, a sensitive plant species that occurs on the Beaverhead and Bitterroot National Forests in Montana. Three permanent transects were established in 1989 on the Beaverhead National Forest. The monitoring results from 1989 and 1990 are discussed in earlier reports (Shelly 1990, Achuff and Shelly 1991).

II. SPECIES INFORMATION

A. REVIEW OF PRESENT STATUS

1. **FEDERAL STATUS:** Penstemon lemhiensis is currently designated as a Category 2 candidate for federal listing by the U.S. Fish and Wildlife Service (U.S. Department of Interior 1990). Category 2 taxa are those "for which there is some evidence of vulnerability, but for which there are not enough data to support listing proposals at this time."

Penstemon lemhiensis is also currently on the U.S. Forest Service Region 1 sensitive species list (U.S. Department of Agriculture 1988; Reel et al. 1989). Sensitive species are "plant and animal species identified by the Regional Forester for which population viability is a concern, as evidenced by: a.) significant current or predicted downward trends in population numbers or density, and/or b.) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution" (Reel et al. 1989).

2. **STATE STATUS:** In Montana, Penstemon lemhiensis is currently ranked as S2 ("very rare and local throughout its range") by the Montana Natural Heritage Program (Achuff 1991). It is also currently categorized as "threatened" in a recent evaluation of rare plants in Montana (Lesica and Shelly 1991). A "threatened" species is one which is "likely to become endangered throughout all or a significant part of its range in Montana in the foreseeable future. Specific threats to known populations of these plants have been identified" (Lesica and Shelly 1991). These state rankings do not currently provide any legal protection for P. lemhiensis.

B. UPDATE OF GEOGRAPHICAL DISTRIBUTION (MONTANA)

No additional populations of Penstemon lemhiensis were newly discovered in Montana in 1991. Thus, the total number of known element occurrences in the state remains at 44. Of these, 42 have been recently documented (1983-1990), one recent report (1987, Medicine Lodge Creek) has not been relocated, and one is an unverified historical record (1947) (Montana Natural Heritage Program database, Helena).

C. POPULATION DEMOGRAPHY AND MONITORING STUDIES

1. DEMOGRAPHIC STUDIES

The three permanent monitoring transects established in 1989 were re-read on 29-30 July 1991, using the methods described in a previous report (Shelly 1990). The population and fecundity data are summarized in Table 1. The numbers of plants and the numbers of fruiting individuals, for each transect over the three-year study period, are displayed in Figures 1-3, pp. 4-6.

In 1991, the total number of plants in the three transects was 115. This total represents a severe continuing decline, from 240 plants in 1989 and 215 plants in 1990. Once again, further decreases occurred in the French Creek - Park Mine and Badger Pass North transects. Total population size decreased from the 1990 level at the French Creek - Discovery Mine transect, but equalled the original total present in 1989.

The total number of plants in the French Creek - Park Mine transect decreased by 31 from the 1990 total, resulting in a population decline of 52%. Extensive sheet erosion appears to be continuing at the site, and may have been a contributing factor in the loss of the 55 established plants that have not survived from 1989 to 1991. The fecundity and vigor of the surviving individuals in this transect was drastically lower in 1991; no plants flowered or fruited. Additionally, no fruiting plants were found in the vicinity of the transect, so we were unable to collect data on seed production for this site.

The total number of plants at the French Creek - Discovery Mine transect decreased by 12 in 1991, resulting in a -25.5% population growth rate.

Table 1. Population density and fecundity data for Penstemon lemhiensis in long-term monitoring transects, Beaverhead National Forest, 1989-1991.

TRANSECT	FRENCH CREEK- PARK MINE			FRENCH CREEK- DISCOVERY MINE			BADGER PASS NORTH		
	(25 plots)			(25 plots)			(50 plots)		
	1989	1990	1991	1989	1990	1991	1989	1990	1991
# plants/transect	88	61	30	35	47	35	117	107	50
density (plants/m ²)	3.5	2.4	1.2	1.4	1.9	1.4	2.3	2.1	1.0
# plants fruiting/transect	29	14	0	8	24	0	23	49	9
# fruits/transect	481	199	0	97	393	0	441	967	28
% plants fruiting	32.9	23.0	0	22.9	51.1	0	19.7	45.8	18
mean # fruits/fruiting plant	16.6	14.2	--	12.1	16.4	--	19.2	19.7	3.1
mean # fruits/inflorescence	11.2	8.0	--	8.1	9.1	--	13.8	9.3	1.9
% plants with 1 rosette	30.7	27.9	30.0	22.9	19.1	34.3	14.6	17.8	28.0
% plants with >1 rosette	64.8	67.2	66.7	77.1	59.6	54.3	74.4	76.6	68.0
% 1-rosette plants with fruit	11.1	5.9	0	0	33.3	0	11.8	15.8	0
% multi-rosette plants with fruit	45.6	31.7	0	29.6	75.0	0	24.1	56.1	26.5
% flowering stems browsed	23.2	4.0	--	47.8	23.3	--	3.0	2.9	20.0
% aborted flowers	N.R.	60.1	--	N.R.	70.0	--	52.4	67.4	82.5
mean # seeds/fruit (±s.d.)	32.7 ±11.2	33.8 ±8.9	N.R.	34.0 ±10.3	31.4 ±8.4	N.R.	36.0 ±12.1	35.6 ±12.7	28.2 ±12.4
# seedlings/transect	4	3	1	0	10	4	13	6	2
# established plants not surviving to next year	--	33	32	--	2	11	--	12	55
# seedlings surviving to next yr	--	1 of 4	1 of 3	--	--	4 of 10	--	5 of 13	2 of 6
population growth rate	--	-31%	-52%	--	+34.3%	-25.5%	--	-8.5%	-53.3%

N.R. = not recorded.

FIGURE 1.

PENSTEMON LEMHIENSIS
French Creek - Park Mine

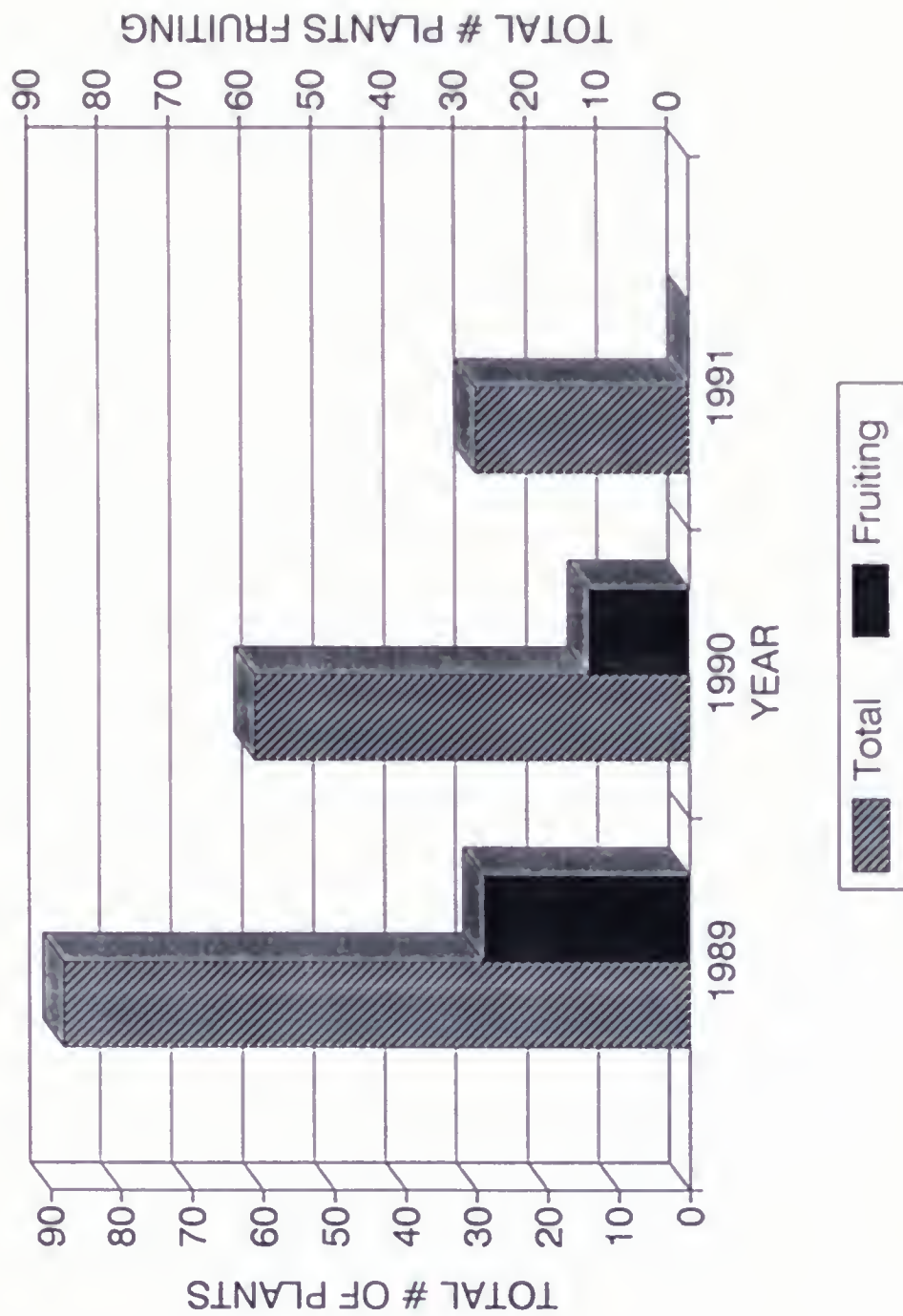


FIGURE 2.

PENSTEMON LEMHIENSIS
French Creek - Discovery Mine

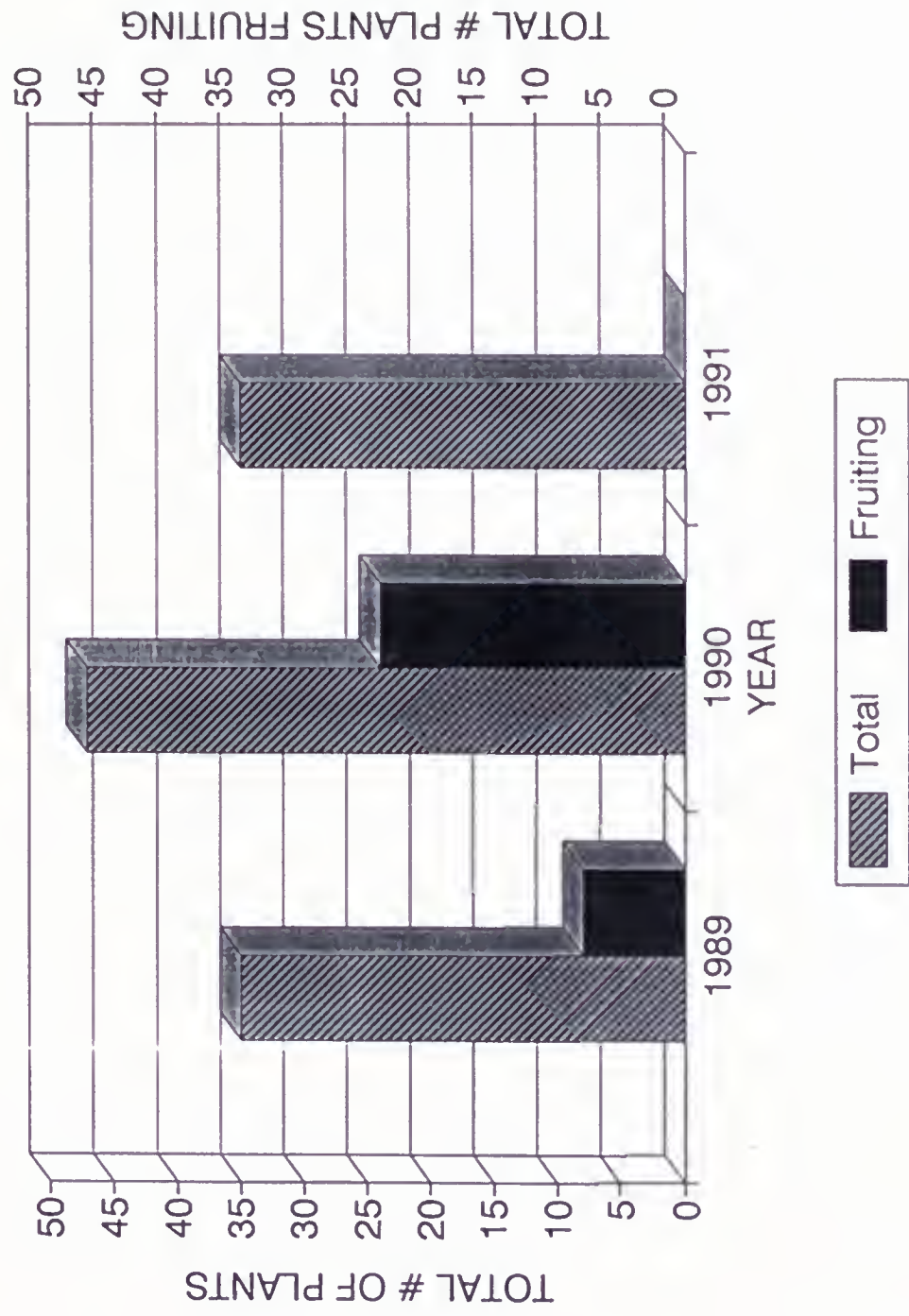
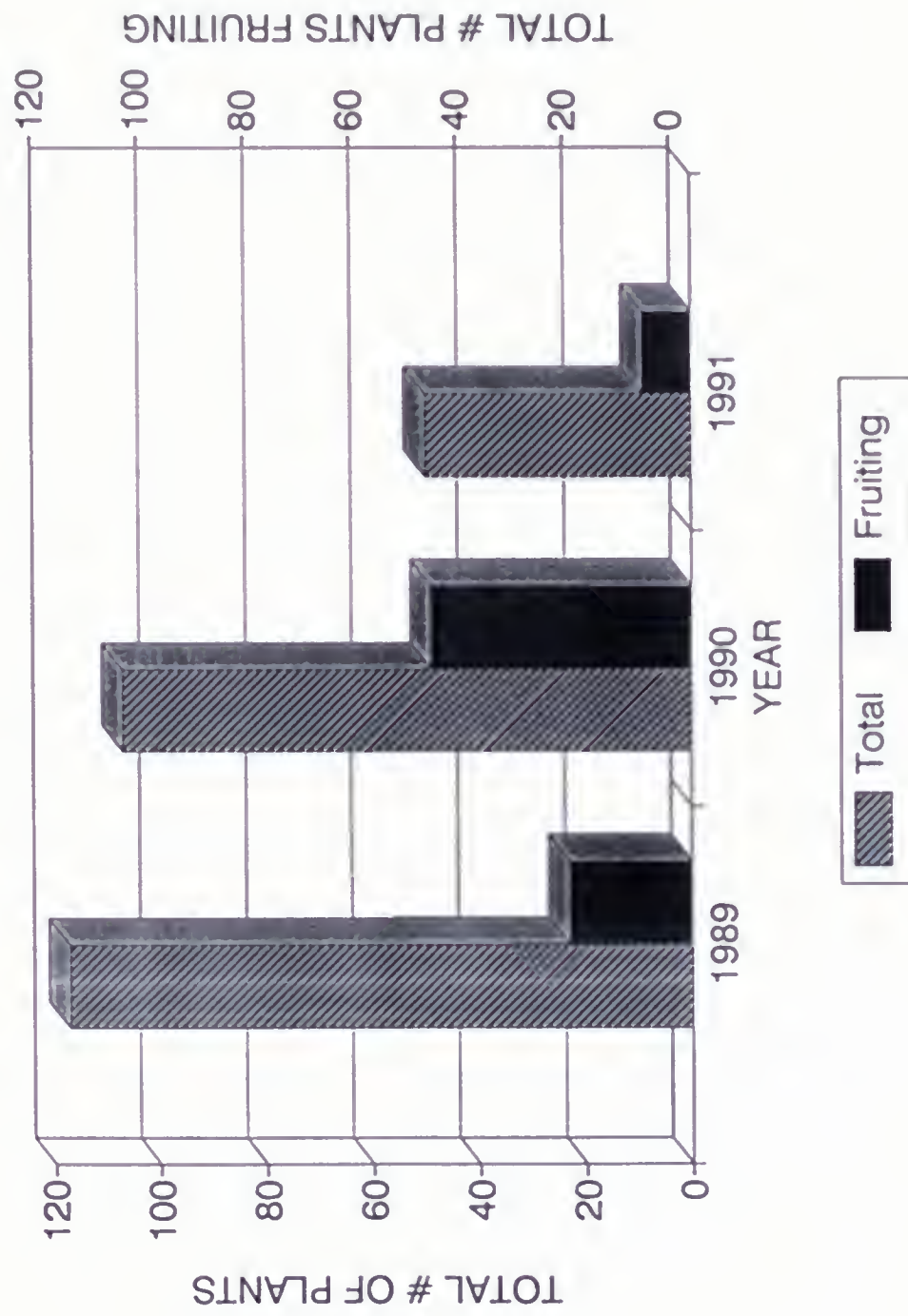


FIGURE 3.

PENSTEMON LEMHIENSIS
Badger Pass North



Thirteen established plants have died since 1989. As at the Park Mine transect, the plants at Discovery Mine showed no reproduction in 1991. This represents an even more severe reproductive decline in this case, as 24 of the 47 plants present in the transect in 1990 had flowered and produced fruit (see Fig. 2). As at the French Creek - Park Mine site, no fruits could be collected in order to determine seed production. Of the populations in the three study transects, the French Creek - Discovery Mine population has been the most stable over the three-year study period in terms of total numbers. However, until 1991 it had the lowest density of plants per m^2 .

The total number of plants in the Badger Pass North transect decreased by 57 in 1991, resulting in a 53.3% population decline from 1990. Sixty-seven established plants died between 1989 and 1991. This transect contained the only fruiting plants found in 1991, but the percentage of such plants was much reduced from 1990 levels (18%, compared to 45.8% fruiting in 1990) (see Figure 3). Other measures of fecundity, including the mean number of fruits per fruiting plant, the mean number of fruits per inflorescence, and the mean number of seeds per fruit, were also reduced from 1990 levels. The percentage of aborted flowers increased to its highest level to date in this transect for the three-year study period. Lastly, the percentage of flowering stems browsed in this transect increased from 2.9% in 1990 to 20.0% in 1991.

The rosettes of most of the surviving plants in the three transects were much reduced in vigor in 1991. They were much smaller in size, and the majority of the green leaves appeared to have been damaged by insects. Thus, it is possible that many plants will continue to perish in future seasons, owing to their severely weakened condition.

The reasons for the severe population declines are currently unknown. Ongoing drought conditions in Montana, possibly coupled with extremely cold weather during the winter of 1990-91, may be contributing factors. No evidence of severe direct disturbance, i.e., from grazing or other vegetation-disturbing activities, has been observed in the three transect locations over the last three years. A weather data recording

station has been established at the Badger Pass site (BLM land), and may provide some insights regarding possibly influential climate patterns.

Additional demographic monitoring studies were established in 1991, for two populations on Bureau of Land Management lands in southwestern Montana (Achuff 1992). These additional monitoring data should further advance an understanding of the overall population trends.

2. POPULATION MONITORING

Two previously documented populations were revisited in 1991. The Red Butte population (012), which contained 142 plants when it was first documented in 1986, consisted of fewer than five living plants in 1991. Similarly, the Kearns Creek population, which consisted of 52 plants when it was documented in 1987, contained only three living plants in 1991. These results, along with the observations from the monitoring transects, indicate that numerous populations of P. lemhiensis in Montana are experiencing severe declines.

III. ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

- A. **MANAGEMENT RECOMMENDATIONS:** The drastic declines in population numbers and fecundity over the last three years indicate that P. lemhiensis populations are experiencing a severe "bottleneck" in southwestern Montana. These declines are undoubtedly placing many populations in increased jeopardy, and rendering them even more vulnerable to management activities that may disturb occupied habitats. For this reason, extreme caution should be exercised in the vicinity of all known populations. It will be especially important to maintain the larger populations occurring in natural habitats, as these will provide the most likely sources for future population reestablishment and recovery.

The recent, severe population declines, coupled with a vulnerability to management activities, indicate that Penstemon lemhiensis should remain on the sensitive species list for Region 1 of the U.S. Forest Service.

Preparation of a U.S. Forest Service species conservation strategy has been initiated. This strategy will provide detailed, population-specific management and conservation guidelines for P. lemhiensis.

B. PROPOSALS FOR FUTURE STUDIES

The first three studies listed below are recommended for continuation during the next two field seasons. In addition, other detailed studies regarding the biology and ecology of P. lemhiensis are suggested.

1. Demographic monitoring studies in the permanent transects should be continued in 1992 and 1993. Upon evaluation of population trends after the 1993 season, a plan for continued periodic monitoring should be developed.
2. Field checks of known populations should be continued, especially in those that have declined recently, such as Badger Pass (005), Red Butte (012), Ermont Gulch (014), and Kearns Creek (018). These population surveys, coupled with the demographic studies, will provide an ongoing measure of population levels in Montana.
3. Continue field surveys for new populations in areas of potential habitat in southwestern Montana.
4. Detailed, sophisticated studies are needed regarding the life history and ecological requirements of P. lemhiensis. Such information is required for the development of sound conservation strategies (Massey and Whitson 1980). In conjunction with the Center for Plant Conservation and the Denver Botanic Gardens, aspects of seed germination behavior and seed bank dynamics could be studied. These organizations are actively pursuing studies of threatened and endangered plants in the northern Rocky Mountain region, and are collecting seeds of such species for inclusion in the national endangered plant seed bank. Owing to the recent, severe population declines, it is recommended that P. lemhiensis be included in these efforts.
5. Recent field surveys in Idaho (Moseley et al. 1990) suggest that an additional factor contributing to population declines may be advancing vegetation succession, i.e., as a result of ongoing fire suppression. Further studies addressing this hypothesis, perhaps coupled with some experimental burns in occupied habitats, may provide further information regarding the influence of plant community dynamics on known populations of P. lemhiensis.

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V. APPENDIX - DEMOGRAPHIC MONITORING TRANSECT DATA

The performance of individual Penstemon lemhiensis plants in the permanent monitoring transects, from 1989 to 1991, is detailed below. The following codes are used:

- A - aborted flowers (no fruit development apparent)
- B - browsed flowering stem
- C - established immature plants (rosette with ≤ 4 leaves)
- D - dead
- F - fruit
- I - inflorescence (flowering stem)
- P - predated fruit
- R - rosette (basal tuft of leaves on mature plant)
- S - seedlings (cotyledons evident or rosette < 15 mm in diameter).

The codes form a formula describing the state of each plant. For example, R5-I2-F17-A25 is a plant with 5 basal rosettes, 2 inflorescences, 17 fruits, and 25 aborted flowers.

FRENCH CREEK - PARK MINE

PLANT	1989	1990	1991
1	a R2	C2	D
	b R1	C2	D
	c R1	R4-B1	D
	d R3-I1-F7	R1	D
	e --	D	--
2	no plants	no plants	no plants
3	a R1	R2	D
	b R1	R2	D
	c S	D	--
	d R1	R1	D
	e R1	D	--
	f R1-I1-F2	D	--
	g R1	R2	D
4	a S	D	--
	b R1	R3	R2
	c R3	D	--
	d R1	D	--
	e R2	R1	D
5	a R2	D	--
	b R1	D	--
6	a R4	R1	D

	b	R1	D	--
	c	S	D	--
	d	R1-I1-F2	D	--
	e	--	S	C1
7	a	R1	D	--
	b	R1	D	--
	c	R1	D	--
	d	R1	R2	R3
8	a	S	C	D
	b	R2	D	--
	c	R1	R1	D
9	a	R3-I2-F5	D	--
	b	R6	R3	D
	c	R10-I1-F11	D	--
10	a	R10-I4-F35-B1	D	--
	b	R3-I1-F11	D	--
	c	R3-I3-F13	D	--
	d	R3	D	--
	e	R2	R1	D
	f	R1	R1	R1
	g	R5-I1-F6	D	--
	h	R1	R3	R2
	i	R1	D	--
	j	R8-I2-F31	R1	D
11	a	R6-I1-F5	D	--
	b	R2	R2	R2
	c	R6	D	--
	d	R3	D	--
	e	R8-I1-F20-B1	D	--
	f	R1	R1	R1
	g	R12-I1-F18	R6-I3-F8-P4-A8	R3
	h	R4-I2-F19	D	--
12	a	R2-I2-F35	D	--
	b	R4	R3-I2-F4-P1-A24	D
	c	R4-I2-F39	R1	C1
	d	R5-I1-F13	R3	R4
	e	R3-I1-F7	D (buried)	--
13	a	R7-I2-F17	D	--
14	a	R2	D	--
	b	R5-I1-F12	D	--
15	a	R5	R4-I2-F11-A28	D
	b	--	S	D
	c	--	--	C1

16	a	R7-I2-F22	R3-I2-F5-A11	C2
	b	--	--	S1
17	a	R1 (dying)	R3	D
	b	R3	D	--
	c	R2-I1-F7	D	--
	d	R5	R2-I1-F2-A6	D
18	a	R5-I1-F16	R3	D
	b	R7-I3-F29	R3	R3
	c	R3	R3	R3
	d	--	S1	C1
19	a	R7	R5-I1-F15-A12	R1
	b	R5	R5-I2-F16-A16	R6
	c	R4-I1-F21	R1-I1-F1-A8	D
	d	R4	R4-I1-F7-A12	R2
	e	R10-I1-F13-B5	R13-I4-F60-A108	R5
	f	R8-I4-F61	R6-I2-F48-A29	D
	g	--	R1	D
20	a	R4-B1	R6	R4
21	a	--	R2	D
22	a	R2	R1	R1-C3
	b	R4	R3	R3
	c	--	R2	D
23	a	R1	D	--
	b	R6-B1-F1	R5	D
	c	R1-I1-F3	C2	D
	d	R1	R2	C1
	e	R3	R1	D
	f	R4-B1	R4-I1-F3-P1-A12	R2
	g	R3	R1	D
	h	--	C2	D
	i	--	R2	D
24		no plants	no plants	no plants
25	a	R1	R1	D
	b	R11	R7-I2-F13-A20	R6
	c	R7-B1	R4-I1-F6-A6	R4
	d	R9-B2	R7	R4-C2
	e	R3	R1	R1
	f	--	R3	R1-C1

FRENCH CREEK - DISCOVERY MINE

PLANT	1989	1990	1991
1 a	R4-B3	R5-I2-F24-A40	C1
b	R3-B2	R1-I1-F7-A24	D
c	R3	R3-I1-F3-A19	R3-C2
d	R3	R4-I1-F9-A37	R4
e	R2	R3-B1-A3	C1
f	R4-B1	R4-I1-F9-A28	D
g	R2	R2-I2-F13-A41	D
h	R1	R2	C3
i	R8-B2	R4-I1-F6-A9-B1-F3-A11	R6-C1
j	R1	R2-F2-A7-B1	R3
k	R2	R3-I1-F5-A21	D
l	R1	R1-I1-F10-A21	D
m	R4-B2-F2	R6-I2-F21-A55-B3	D
n	R1	R3-I2-F29-A54	R2
o	R2	D	--
p	R4-B1	R5-I3-F32-A72	R5
q	--	S1	C1
r	--	R1	C1
s	--	S1	D
t	--	--	S1
2 a	R1	R3	R3
b	R6-B4	R8-I1-F4-A14	R8
c	R6-I1-F1	R4-I3-F23-A51-B1	R2
d	--	C1	R1
e	--	C1	C1
f	--	S1	D
3-5	no plants	no plants	no plants
6 a	R4-B1	R11-I1-F5-A37	R8
b	R4-I1-F6	R6	R1
c	--	S1	C1
d	--	S3	C2
e	--	S2	D
f	--	--	S1
7 a	R1	R5	R5
b	R2-I1-F20	R1	R2
c	R1	R1	R2
d	R5-B1-F1	R4-I1-F5-A12	R4
e	--	R1	R1
f	--	S1	D
g	--	S1	C1
h	--	S1	D
i	--	--	S1
j	--	--	S1

8		no plants	no plants	no plants
9	a	R6-I4-F7-B2	R1-I6-F75-A213-B1-F1-A16	D
10-15		no plants	no plants	no plants
16	a	R4	R2-I1-F5-A12	R1
	b	R8-I4-F29	D	--
17-22		no plants	no plants	no plants
23	a	R3-I1-F31	R2-I3-F18-A26-B1	D
24	a	R4	R4-I2-F24-A11	D
25	a	R2	R2 (low vigor)	D
	b	R3	R3-I1-F10-A14	R7
	c	R5	R3-I3-F29-A31	D
	d	R1	R2	R2
	e	R5-B1	R6-I3-F21-A28-B1-A11	R5
	f	--	S	C1

BADGER PASS NORTH

PLANT	1989	1990	1991
1 a	R3	R4-I1-F15-A9	D
b	R6-I2-F17-A64 (unknown if the 64 fruits developed)	R1	D
c	R1	D	--
d	S9	C4, S5(D)	C1
e	R3-I1-F11-A11	D	--
f	R3	R1-I1-F1-A15	D
g	R3	R3-I1-F11-A25	D
h	S	D	--
i	R5	R1-I1-F16-A20	D
j	R6	R8	R7-I1-P1-A17
k	--	S	R1
2 a	S	C	D
b	S	S(D)	--
c	S	S(D)	--
d	R2	R1	R1
e	R5	R1	D
f	R2	D	--
g	R2	R1-I1-F0-A14	D
h	R2	D	--
i	R1	R3-I1-F4-A20	R1
j	R2	D	--
k	C	R1	C1
l	R2	R4	R4
m	C	R3	R2
n	R8	R4-I3-F0-A78	R1
o	--	S	S
p	--	--	C1
3 a	R2	R3-I1-F4-A19	R1
b	R7	R5	D
c	R1	R1	D
d	R5-I1-F8-A19	R5	R5
e	R5-I2-F17-A25	R7-I4-F17-A36	R2
f	--	S	D
4-27	no plants	no plants	no plants
28 a	R7-I3-F27-A15	R6-I2-F29-A29	R10
b	R3	R4	D
29 a	R2	R2-I1-F14-A20	R2
30 a	R4-I1-F3-A23	R4	R2
b	R2	R2	R4

31	a	R3-I1-F8-A16	R3	R6-I1-A2
	b	R7-I1-F23-A11	R11-I3-F45-A46	R14
	c	C	R1	R1
	d	R5-I1-F27-A10	D	--
32		no plants	no plants	no plants
33	a	R3-I1-F9-A6-B1	R8-I1-F27-A10	R2-I1-F1-P4-A9
34		no plants	no plants	no plants
35	a	R1	R2	R4
	b	R5	R11-I2-F44-A13-B1	R8-I1-F2-A5-B1
	c	--	--	R1
36	a	R8	R14-I1-F11-A8	R12-I1-P5-A8
	b	R2	R2	R2-I1-F1-P11-A18
	c	C	R2	R2
	d	R7	R10	D
37	a	R3	R2	R5
	b	R3	R4-I2-F15-A25	D
	c	R6	R5-I1-F32-A11	R4-I1-F9-A10
	d	R3	R7-I2-F25-A16	R9
	e	R7	R7	R1
	f	R3	R5	R2-I1-F1-P6-A16
	g	R6	R5	R2
	h	--	S	D
38	a	R1	R1	D
	b	R9	R5-I2-F1-A90	D
	c	R1	R1	D
	d	R6	R5-I2-F9-A51	D
	e	R4	R2	D
	f	R4	R4-I4-F39-A35	D
	g	R11	R7	R1-C5
	h	R9-I1-F12-A12	R9-I4-F21-A88	D
	i	--	R2-I2-F0-A41	D
39	a	R6	R3	D
	b	R2	D	--
	c	R1	R2	D
	d	R2	R4-B1	D
	e	R3	R3-I1-F2-A5	D
	f	R3	R5-I3-F20-A115	D
	g	R1-I1-F14-A22	R3	R1
	h	R5+	R3-I1	D
	i	R2	R4-I3-F8-A40	D
	j	R5-I2-F16-A64	D	--
	k	R1-I1-F13-A17	R4-I1-F16-A22	D
	l	R7-I1-F29-A12	R7	R2
	m	R6	R7-I1-F33-A23	R4

n	R6	R2-I2-F20-A31	D
o	--	R2-I1-F9-A14	D
40 a	R1	R8-I1-F7-A35	D
b	R2-I1-F0-A34	R3	D
c	R5-I1-F18-A15	R1	D
d	R4	R3-I3-F3-A90	D
e	R5	D	--
f	R3	R1-I1-F0-A35	D
g	R1	D	--
h	R4-I2-F11-A15	D	--
i	R6-I2-F31-A16	D	--
j	R5	R1-I1-F7-A22	D
k	R13	R13-I4-F16-A70	D
l	R6	R9-I4-F19-A127	D
m	R2	R1	D
n	R5	R7-I3-F14-A72	D
o	R5	R3-I2-F5-A29-B1	D
p	R3	R1-I1-F0-A18	D
q	R2	R2-I1-F4-A15	D
r	--	R2-I1-F1-A40	D
s	--	R1	D
41 a	R3	R6-I1-F25-A8	R2-I1-A8-B1
b	R4-I1-F25-A27	R12-I2-F89-A22	R12-I2-F1-A8-B2
c	R4	R6	R12
d	R15+	R10-I5-F11-A129	D
e	R16	R23-I3-F62-A33	R12-I2-F8-P5-A13
f	(part of d)	R5-I1-F5-A34	C1
g	--	S1	D
h	--	S1	D
42 a	R4	R4-I2-F37-A49	D
b	R5-I2-F41-A20	R11-I1-F23-A7	R5-I1-F1-P4-A7
43 a	R8	R2	to F
b	R1	R4	D
c	R6-I1-F29-A3	R5-I2-F9-A55	D
d	R9-I2-F30-A18	R3-I3-F47-A43	D
e	R4	R5-I1-F15-A10	R3
f	(part of a)	R4-I1-F13-A33	R6
44 a	R10	R11-I2-F19-A15	R4
b	R8	R3	R3-I1-F4-A11
c	--	--	S
45 a	--	R1	D
46-47	no plants	no plants	no plants
48 a	R1	R3	D
b	R2	R3	R3

c	R8-I1-F22-A10	R8-I3-F48-A36	D
49	no plants	no plants	no plants
50 a	R4	R3	D

